



(19) Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) EP 0 546 580 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
16.10.1996 Bulletin 1996/42

(51) Int Cl. 6: D04H 1/64

(21) Application number: 92121195.9

(22) Date of filing: 11.12.1992

(54) Nonwoven, coated substrates and method of applying a coating at high bath concentration
and low wet pick-up

Beschichtete Vliesstoffsubstrate und Verfahren zum Aufbringen einer Beschichtung bei hoher
Badkonzentration und niedriger Feuchtigkeitsaufnahme

Substrat non-tissé couché et procédé d'application d'un revêtement à haute concentration et prise de
fluide faible

(84) Designated Contracting States:
BE DE ES FR GB IT NL SE

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(30) Priority: 13.12.1991 US 806747

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(43) Date of publication of application:
16.06.1993 Bulletin 1993/24

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US-A- 4 356 229 US-A- 4 379 192

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Description

The present invention relates to a process for coating a material of the type as defined in the preamble of claim 1 and to a coated substrate of the type as described in the preamble of claim 10.

A process for coating a material and a coated substrate of this type are disclosed in GB-A-941 073. This publication describes a process and several apparatus for impregnating fibrous webs with solutions or the like. No specific solution and no specific concentration thereof are described. The fibrous web is impregnated with the solution by applying the solution to a first roll and then passing the fibrous web supported on a continuous band of wire mesh through a nip formed between this first roll and a second roll, while the wire mesh contacts the first roll. The impregnating solution will be uniformly applied to the interstices of the wire mesh band and will thereafter be transferred to the fibrous web.

Nonwoven, hydrophobic substrates or materials are well known in the art. Many disposable products such as diapers and sanitary napkins are constructed with top sheets made of nonwoven, hydrophobic material. The outer surface of these top sheets is typically treated with a wetting agent to allow fluid to more readily penetrate the outer surface for capture by an underlying absorbent pad. Top sheets made with a hydrophobic material having an outer surface treated with a wetting agent are preferred for such applications over top sheets made with a hydrophilic material because the wetting agent provides hydrophilic properties to the outer surface to improve fluid penetration without compromising the desired hydrophobic properties of the inner surface of the top sheet. The hydrophobic inner surface retains the penetrated fluid and inhibits flow back of the penetrated fluid to the outer surface, thus acting as a "one-way valve".

It is desired to apply the wetting agent to the nonwoven material in a uniform concentration for aesthetics and to provide uniform wettability to the outer material. Nonwoven materials, however, typically have irregular surfaces onto which it is difficult to uniformly apply the wetting agent. This is particularly so if a coating solution having a high concentration of wetting agent is used. For these reasons, wetting agents are typically applied by spraying, direct printing, or roller coating a low concentration solution of the wetting agent onto the outer surface of the material. One example of a material treated using conventional techniques is disclosed in US-A-4,585,449 to Karami.

One disadvantage of coating nonwoven materials using a low concentration solution is that a large amount of the solvent (usually water) is typically "picked-up" by the material. The wet "pick-up" is removed by drying the coated material to evaporate the solvent. This drying step is detrimental to the strength and softness of the material, as it has been observed that the action of wetting and drying a nonwoven material significantly de-

creases the tensile strength of the material. Thus, there is a need in the art for a method of uniformly applying a wetting agent to a nonwoven material which results in a uniform application of the wetting agent on the material without a significant decrease in the tensile strength of the material.

The present invention fills the above need by providing a process for uniformly applying a high concentration solution of a wetting agent to a fibrous substrate such as a nonwoven material in accordance with the features of claim 1. The application of a high concentration solution results in lower wet pick-up by the material, which reduces subsequent drying of the material and the associated loss in tensile strength. This provides a strong, nonwoven material having a uniform coating.

Generally described, the present invention provides a process for coating a material, the process comprising the steps of introducing a coating solution to a first rotating roll, the coating solution containing between about 20 and 30 percent by weight of a wetting agent compound and between about 70 and 80 percent by weight of a solvent; and passing the material through a nip defined between the first roll and a second rotating roll positioned adjacent the first roll, wherein a portion of the coating solution is applied by the first roll to a surface of the material in an amount such that the wetting agent is applied to the material in an amount of between about 0.1 and 0.5 percent by weight of the material, and the solvent is applied to the material in an amount not exceeding about 1 percent by weight of the material.

Another aspect of the present invention provides a coated substrate, comprising a nonwoven material and a substantially uniform coating on a surface of the nonwoven material. The coating comprises a wetting agent applied to the nonwoven material in an amount of between about 0.1 and 0.5 percent by weight of the nonwoven material and a solvent applied to said nonwoven material in an amount not exceeding about 1 percent by weight of said material.

Thus, it is an object of the present invention to provide an improved coated material and process for coating a material.

A further object of the present invention is to provide a process for coating a fibrous material using a high concentration coating solution such that wet pick-up and loss of tensile strength are reduced and drying requirements are reduced and may be eliminated.

A still further object of the present invention is to provide a process for coating a fibrous material which does not require drying of the coated material and yet microbiological testing confirms that no unacceptable levels of bacteria are present.

It is also an object of the present invention to provide a coated material which has improved tensile strength and in one preferred embodiment is hydrophobic on one surface and hydrophilic on the other, exhibiting one-way valve properties.

Figure 1 is a perspective drawing of the "inverted L"

differential offset printer used to apply a coating to a material in accordance with the present invention.

Figure 2 is a graph showing the percent surface concentration of the wetting agent on the coated material of the present invention as a function of cross-direction position.

Figure 3 is a graph showing the percent surface concentration of the wetting agent on the coated material of the present invention as a function of machine-direction position.

Figure 4 is a graph showing the percent surface concentration of the wetting agent on the coated material of the present invention as a function of gravure roll speed.

While the invention will be described in connection with a preferred embodiment and method, it will be understood that we do not intend to limit the invention to that embodiment or method. On the contrary, we intend to cover all alternatives, modifications, and equivalents as may be included within the scope of the invention as defined by the appended claims.

The nonwoven material 18 is preferably a hydrophobic, nonwoven spunbonded web having a basis weight of between about 16,9 and 33,9 g/m² (0.5 and 1.0 ounces per square yard, "osy") although the basis weight is not known to be critical and may be higher, for example, up to 84,8 g/m² (2.5 osy) depending on the desired application. Such material is well known in the art and may be prepared in conventional fashion such as illustrated by the following patents: Dorsch et al. US-A- 3,692,618; Kinney US-A- 3,338,992 and US-A- 3,341,394; Levy US-A- 3,502,538; Hartmann US-A- 3,502,763 and US-A- 3,909,009; Dobo et al. US-A- 3,542,615; Harmon CA-A- 803,714; and Appel et al. US-A- 4,340,563. Other nonwoven materials and methods for forming nonwoven materials are contemplated for use with the present invention.

The wetting agent 14 is applied to a surface 50 of the nonwoven material 18 using the printer 10 to provide hydrophilic properties to the surface 50. The printer 10 is preferably a "differential" type printer, with the term "differential" referring to printers wherein the gravure roll speed may be varied with respect to the material or line speed to allow compensation for basis weight changes without changing the gravure roll. The most preferred printer is that which is referred to in the art as an "inverted L" differential offset printer, such as is shown in Fig. 1. The wetting agent 14 is preferably a non-ionic surfactant. A preferred wetting agent for use with nonwoven materials having a basis weight up to about 27,2 g/m² (0.8 osy) is "Triton X-102," available from Union Carbide. "Gemtex SM-33", available from Finetex Inc. is a preferred wetting agent for use with nonwoven materials having a basis weight in excess of about 27,1 g/m² (0.8 osy), particularly where "one-way valve" properties are not necessary. For certain personal care applications, it has been experienced that a surface concentration of the wetting agent on the material of between about 0.1

percent to 0.5 percent, broadly and, preferably, between about 0.16 percent and 0.38 percent is desired. The "fountainless pan" doctor blade system 44, supplies a uniform application of a solution containing the wetting agent 14 to the gravure roll 38 in a conventional manner. The solution is preferably a high concentration aqueous solution having the wetting agent 14 present in an amount of between about 20 and 100 percent, and most preferably about 25 percent, by weight of the solution.

5 The gravure roll 38 is preferably a metal roll of a type conventionally used in the printing art, and having a cell pattern known in the art as a "quad" pattern with between about 300 and 700 cells per 25,4 mm (1 inch) and a cell size of between about 1.5 and 4.0 CBM (cubic billion microns, volume per 6,45 cm² or 1 square inch). The most preferred gravure roll is one known in the art as a 550 (cells per 25,4 mm or 1 inch) quad, 1.7 CBM. The gravure roll preferably rotates at a speed of between about 20 and 120 percent of the line speed, and most preferably about 60 percent of the line speed (line speed is described below as preferably being between about 91,5 and 457,5 m/min (300 and 1,500 feet per minute). A graph showing the percent surface concentration of the wetting agent as a function of gravure roll

20 speed for a representative sample is shown in Fig. 4.

25 The transfer roll 24 is preferably a rubber roll of a type conventionally used in the printing art, and having a durometer hardness of between about 60 and 85. The gravure roll 38 is spaced apart from the transfer roll 24 such that in operation a desired amount of the coating solution transfers to the transfer roll for subsequent application to the nonwoven material. The distance between the transfer roll 24 and the gravure roll 38 which defines the nip 39 is preferably between about 1,5 and 35 12,7 mm (1/16 and 1/2 inch) to achieve the desired surface concentration, and is optimally about 4,77 mm (3/16 inch) when applying the coating solution to nonwoven materials having a basis weight of about 23,7 g/m² (0.7 osy). The transfer roll 24 preferably rotates at a rate which advances the material at a line speed of between about 91,5 and 457,5 m/min (300 and 1,500 feet per minute), with an optimum line speed of about 152,5 m/min (500 feet per minute). The backing roll 20 is preferably either a metal or rubber roll of a type well known in the printing art, having a durometer hardness of about 40 90. The backing roll 20 rotates at a rate which provides the same line speed as the transfer roll 24. The spacing between the backing roll 20 and the transfer roll 24 which defines the nip 30 is preferably between about 6,3 and 19,1 mm (1/4 and 3/4 inch) and is optimally about 45 9,5 mm (3/8 inch) when coating nonwoven materials having a basis weight of about 23,7 g/m² (0.7 osy).

50 By using the differential printer 10 for coating the nonwoven material 18, the resulting coated material 34 has a more uniform coating of wetting agent and has improved tensile strength over conventionally prepared coated materials. In order to evaluate the effect of coating a nonwoven material using a high concentration bath

or solution, a representative sample was produced by applying a 25 percent by weight "Triton X-102" aqueous solution to a 23,7 g/m² (0.7 osy) nonwoven, hydrophobic material. The solution was applied using an "inverted L" differential offset printer producing a line speed of 152,5 m/min (500 fpm) and a gravure roll speed of 91,5 m/min (300 fpm) (60% line speed). The wet pick-up for the representative sample was determined to be about 0.9 percent and the average surface concentration of the wetting agent was about 0.3 percent solids (coat weight). No drying was necessary. This yielded a uniform distribution of about 0.24 grams of coating solution per 0,8 m² (1 square yard).

With reference to Figs. 2 and 3, one can see graphically the uniformity of the surface concentration of the wetting agent on the representative sample in the cross-direction (Fig. 2) and in the machine-direction (Fig. 3). The representative sample exhibited overall a 5.0 percent coefficient of variation in surface concentration across the material, and materials of the invention will generally exhibit a coefficient of variation in surface concentration of 10.0 percent or less. Loss in tensile strength for the representative sample was determined (in accordance with RTM-6200) by comparing the tensile strength of treated material with untreated material for the same cross-direction or deckle position. Material treated in accordance with the present invention experienced a 5 percent loss in tensile strength. This compares with a typical tensile strength loss of at least 21 percent for coated materials prepared utilizing spray treatment and treatments requiring secondary drying over steam cans.

The printing process of the present invention coats the material from the transfer roll; therefore, only one side of the coated material is hydrophilic, while the other side is hydrophobic. Hydrophilic material is wettable material that produces less than 20 milliliters of runoff; hydrophobic material produces greater than 20 milliliters of runoff. A material having a hydrophilic and hydrophobic surface rapidly allows fluid to pass through and does not allow it to flow back. Thus, such material acts as a "one way valve." It has been observed that materials having basis weights between 16,9 g/m² and 33,9 g/m² (0.5 and 1.0 osy) which are treated in accordance with the present invention behave as one way valves when, after treatment, they are not wound up into roll form in a manner that causes contact between opposing sides of the material. It has also been observed that when materials having a basis weight of less than about 28,8 g/m² (0.85 osy) are rolled up after application of the wetting agent, some of the wetting agent transfers to the untreated side, producing a two-sided hydrophilic material. The time required for the wetting agent to transfer to the untreated side being dependent upon the basis weight. Materials having a basis weight greater than about 28,8 g/m² (0.85 osy) remain one way valves in sheet or roll form. If two sided hydrophilic behavior is desired for materials having a basis weight in excess of 28,8 g/m² (0.85

osy), a conventional four roll differential printer (dual printer) may be utilized to apply the wetting agent to both sides.

5 Micropore filtration testing of materials treated in accordance with the invention showed reduced levels of Class I, Class II and Class III bacteria when compared with untreated materials. Class I included *Bacillus* sp., *Corynebacterium*, other gram positive rods, mold and yeast (other than *Candida albicans*). Class II included 10 *Staphylococcus* sp. (other than *S. Aureus*), *Pseudomonas* sp. (other than *P. Aeruginosa*), *Enterobacteriaceae* (other than *E. Coli* and *Salmonella* sp.), other gram positive cocci, Oxidative-Fermentative bacteria, and other gram negative rods. Class III included *S. aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Salmonella* sp., and *Candida albicans*. While the control had a total CFU of 17, none of the treated samples exceeded 10 CFU.

15 The foregoing description relates to preferred embodiments of the present invention, and modifications or alterations may be made without departing from the scope of the invention as defined in the following claims.

25 Claims

1. A process for coating a material (18), said process comprising the steps of:

30 introducing a coating solution to a first rotating roll (24), and

35 passing said material (18) through a nip (30) defined between said first roll (24) and a second rotating roll (20) positioned adjacent said first roll (24), wherein a portion of said coating solution is applied to a surface (50) of said material (18),

40 characterised in that

said coating contains between about 20 and 30 percent by weight of a wetting agent (14) and between about 70 and 80 percent by weight of a solvent and is applied by said first roll (24) to said surface (50) of said material (18) in an amount such that,

45 50 a) said wetting agent (14) is applied to said material (18) in an amount of between about 0.1 and 0.5 percent by weight of said material (18), and

55 b) said solvent is applied to said material (18) in an amount not exceeding about 1 percent by weight of said material (18).

2. The process of claim 1, wherein after said coating solution is transferred to said surface (50) of said material (18), said material (18) has a tensile

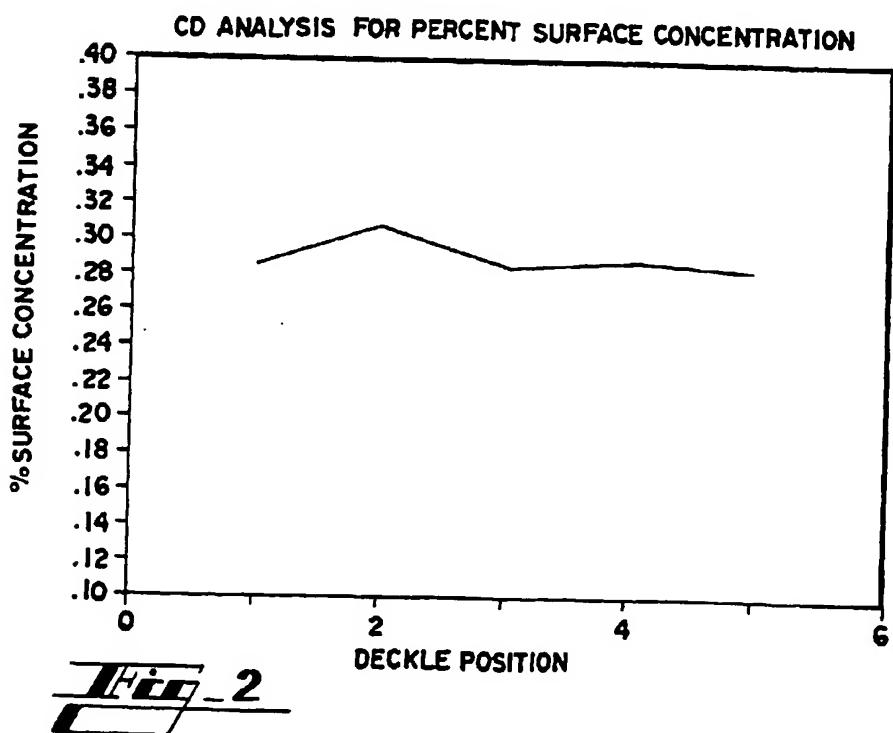
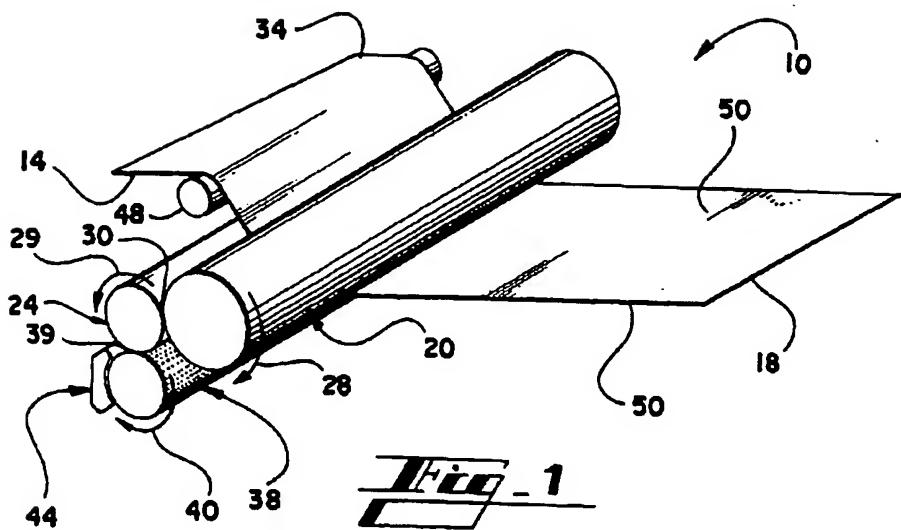
- strength which is at least 90 percent of the tensile strength of said material (18) before it is coated.
3. The process of claim 1 or 2, wherein said material (18) is a nonwoven material.
4. The process of claim 3, wherein said nonwoven material comprises a nonwoven, hydrophobic material having a basis weight of between about 16,9 and 33,9 g/m² (0.5 and 1.0 ounces per square yard).
5. The process of any one of claims 1 to 4, wherein said nip (30) is formed by positioning said first roll (24) and said second roll (20) between about 6,3 and 19,1 mm (1/4 and 3/4 inch) apart.
6. The process of any one of claims 1 to 5, wherein a third roll (38) is positioned to apply said coating solution to said first roll (24).
7. The process of claim 6, wherein said third roll (38) is positioned between about 1,5 and 12,7 mm (1/16 and 1/2 inch) apart from said first roll (24).
8. The process of any one of claims 1 to 7, wherein said wetting agent (14) is a surfactant.
9. The process of any one of claims 1 to 8, wherein said coating is applied to said surface (50) by a differential printer (10).
10. A coated substrate (34), comprising a fibrous, nonwoven material (18) and a coating on a surface (50) of said nonwoven material (18),
characterised in that
 said coating comprises
- a) a wetting agent (14) applied to said nonwoven material (18) in an amount of between about 0.1 and 0.5 percent by weight of the nonwoven material (18), and
- b) a solvent applied to said nonwoven material (18) in an amount not exceeding about 1 percent by weight of said material (18),
- wherein said coating having a coefficient of variation in surface concentration of 10 percent or less.
11. The coated substrate of claim 10, wherein said coated substrate (34) has a tensile strength which is at least 90 percent of the tensile strength of the nonwoven material (18).
12. The coated substrate of claim 10 or 11 wherein said solvent is water.
13. The coated substrate of any one of claims 10 to 12, wherein said wetting agent (14) comprises a surfactant.
14. The coated substrate of any one of claims 10 to 13, wherein said coating is applied to said surface (50) using a differential printer (10).
15. The coated substrate of any one of claims 10 to 14, wherein said wetting agent (14) provides hydrophilic properties on the coated surface (50) of said substrate (34) and the opposite side of said substrate (34) is hydrophobic.
- Patentansprüche**
1. Verfahren zum Beschichten eines Materials (18), wobei das Verfahren die folgenden Verfahrensschritte enthält:
- Zufügen einer Beschichtungslösung zu einer ersten, sich drehenden Walze (24), und
- Hindurchleiten des Materials (18) durch einen Spalt (30), der zwischen der ersten Walze (24) und einer zweiten sich drehenden Walze (20) definiert ist, die benachbart der ersten Walze (24) angeordnet ist, wobei ein Bereich der Beschichtungslösung auf eine Oberfläche (50) des Materials (18) aufgebracht wird,
- dadurch gekennzeichnet, daß die Beschichtung zwischen etwa 20 und 30 Gewichtsprozent eines Benetzungsmittels (14) und zwischen 70 und 80 Gewichtsprozent eines Lösungsmittels enthält, und durch die erste Walze (24) auf die Oberfläche (50) des Materials (18) in einer Menge aufgebracht wird, daß
- a) das Benetzungsmittel (14) auf das Material (18) in einer Menge zwischen etwa 0,1 und 0,5 Gewichtsprozent des Materials (18) aufgebracht wird und
- b) das Lösungsmittel auf das Material (18) in einer Menge aufgebracht wird, die 1 % des Gewichtes des Materials (18) nicht übersteigt.
2. Verfahren nach Anspruch 1, wobei das Material (18), nachdem die Beschichtungslösung auf die Oberfläche (50) des Materials (18) übertragen wurde, eine Zugfestigkeit aufweist, die mindestens 90 % der Zugfestigkeit des Materials (18) beträgt, bevor dieses beschichtet ist.
3. Verfahren nach Anspruch 1 oder 2, wobei das Material (18) ein nichtgewebtes Material ist.

4. Verfahren nach Anspruch 3, wobei das nichtgewebte Material ein nichtgewebtes, hydrophobes Material mit einem Flächengewicht zwischen etwa 16,9 und 33,9 g/m² (0,5 und 1,0 Unzen pro Quadratyard) aufweist.
5. Verfahren nach einem der Ansprüche 1 bis 4, wobei der Spalt (30) dadurch gebildet wird, indem die erste Walze (24) und die zweite Walze (20) in einem Abstand zwischen etwa 6,3 und 19,1 mm (1/4 und 3/4 Zoll) zueinander angeordnet werden.
6. Verfahren nach einem der Ansprüche 1 bis 5, wobei eine dritte Walze (38) angeordnet wird, um die Beschichtungslösung auf die erste Walze (24) aufzubringen.
7. Verfahren nach Anspruch 6, wobei die dritte Walze (38) zwischen etwa 1,5 und 12,7 mm (1/16 und 1/2 Zoll) von der ersten Walze (24) entfernt angeordnet wird.
8. Verfahren nach einem der Ansprüche 1 bis 7, wobei das Benetzungsmittel (14) ein oberflächenaktives Mittel ist.
9. Verfahren nach einem der Ansprüche 1 bis 8, wobei die Beschichtung auf die Oberfläche (50) durch einen Differentialdrucker (10) aufgebracht wird.
10. Beschichtetes Substrat (34) mit einem nichtgewebten Fasermaterial (18) und einer Beschichtung an einer Oberfläche (50) des nichtgewebten Materials (18), dadurch gekennzeichnet, daß die Beschichtung umfaßt
- a) ein Benetzungsmittel (14), das auf das nichtgewebte Material (18) in einer Menge zwischen etwa 0,1 und 0,5 Prozent des Gewichtes des nichtgewebten Materials (18) aufgebracht ist, und
 - b) ein Lösungsmittel, das auf das nichtgewebte Material (18) in einer Menge aufgebracht ist, die 1 % des Gewichtes des Materials (18) nicht übersteigt, und
- wobei die Beschichtung einen Variationskoeffizienten der Oberflächenkonzentration von 10 % oder weniger aufweist.
11. Beschichtetes Substrat nach Anspruch 10, wobei das beschichtete Substrat (34) eine Zugfestigkeit hat, die mindestens 90 % der Zugfestigkeit des nichtgewebten Materials (18) ausmacht.
12. Beschichtetes Substrat nach Anspruch 10 oder 11, wobei das Lösungsmittel Wasser ist.
13. Beschichtetes Substrat nach einem der Ansprüche 10 bis 12, wobei das Benetzungsmittel (14) ein oberflächenaktives Mittel enthält.
14. Beschichtetes Substrat nach einem der Ansprüche 10 bis 13, wobei die Beschichtung auf die Oberfläche (50) unter Verwendung eines Differentialdrückers (10) aufgebracht ist.
15. Beschichtetes Substrat nach einem der Ansprüche 10 bis 14, wobei das Benetzungsmittel (14) der beschichteten Oberfläche (50) des Substrats (34) hydrophile Eigenschaften verleiht und wobei die gegenüberliegende Seite des Substrats (34) hydrophob ist.

Revendications

20. 1. Procédé pour recouvrir un matériau (18), ledit procédé comprenant les étapes consistant à:
- introduire une solution de revêtement sur un premier rouleau rotatif (24), et passer ledit matériau (18) à travers un pincement (30) défini entre ledit premier rouleau (24) et un deuxième rouleau rotatif (20), placé de façon adjacente audit premier rouleau (24), dans lequel une partie de ladite solution de revêtement est appliquée sur une surface (50) dudit matériau (18)
25. caractérisé en ce que ledit revêtement contient entre environ 20 et 30 pour cent en poids d'un agent mouillant (14), et entre environ 70 et 80 pour cent en poids d'un solvant, et il est appliqué par ledit premier rouleau (24) sur ladite surface (50) dudit matériau (18), en une quantité telle que,
30. a) ledit agent mouillant (14) est appliqué sur ledit matériau (18) en une quantité comprise entre environ 0,1 et 0,5 pour cent en poids dudit matériau (18), et
35. b) ledit solvant est appliqué audit matériau (18) en une quantité qui ne dépasse pas environ 1 pour cent en poids dudit matériau (18).
40. 2. Procédé selon la revendication 1, dans lequel, après que ladite solution de revêtement a été transférée sur ladite surface (50) dudit matériau (18), ledit matériau (18) a une résistance à la traction qui est au moins de 90 pour cent de la résistance à la traction dudit matériau (18) avant qu'il soit recouvert.
45. 3. Procédé selon la revendication 1 ou 2, dans lequel ledit matériau (18) est un matériau non tissé.

4. Procédé selon la revendication 3, dans lequel ledit matériau non tissé comprend un matériau non tissé hydrophobe ayant un poids de base compris entre environ 16,9 et 33,9 g/m² (0,5 et 1,0 once par yard carré). 5
5. Procédé selon l'une quelconque des revendications 1 à 4, dans lequel ledit pincement (30) est formé en positionnant ledit premier rouleau (24) et ledit deuxième rouleau (20) séparés d'environ 6,3 à 19,1 mm (1/4 et 3/4 de pouce). 10
6. Procédé selon l'une quelconque des revendications 1 à 5, dans lequel un troisième rouleau (38) est positionné pour appliquer ladite solution de revêtement sur ledit premier rouleau (24). 15
7. Procédé selon la revendication 6, dans lequel ledit troisième rouleau (38) est positionné séparé d'environ 1,5 à 12,7 mm (1/16 et 1/2 pouce) dudit premier rouleau (24). 20
8. Procédé selon l'une quelconque des revendications 1 à 7, dans lequel ledit agent mouillant est un tensioactif. 25
9. Procédé selon l'une quelconque des revendications 1 à 8, dans lequel ledit revêtement est appliqué sur ladite surface (50) par une imprimateur différentielle (10). 30
10. Substrat couché (34), comprenant un matériau fibreux non tissé (18) et un revêtement sur une surface (50) dudit matériau non tissé (18), caractérisé en ce que ledit revêtement comprend : 35
- a) un agent mouillant (14) appliqué audit matériau non tissé (18) en une quantité comprise entre environ 0,1 et 0,5 pour cent en poids du matériau non tissé (18), et 40
 - b) un solvant appliqué audit matériau non tissé (18), en une quantité qui ne dépasse pas environ 1 pour cent en poids dudit matériau (18), dans lequel ledit revêtement a un coefficient de variation de concentration en surface de 10 pour cent ou moins. 45
11. Substrat couché selon la revendication 10, dans lequel ledit substrat couché (34) a une résistance à la traction qui est au moins de 90 pour cent de la résistance à la traction du matériau non tissé (18). 50
12. Substrat couché selon la revendication 10 ou 11, dans lequel ledit solvant est de l'eau. 55
13. Substrat couché selon l'une quelconque des revendications 10 à 12, dans lequel ledit agent mouillant (14) comprend un tensioactif.



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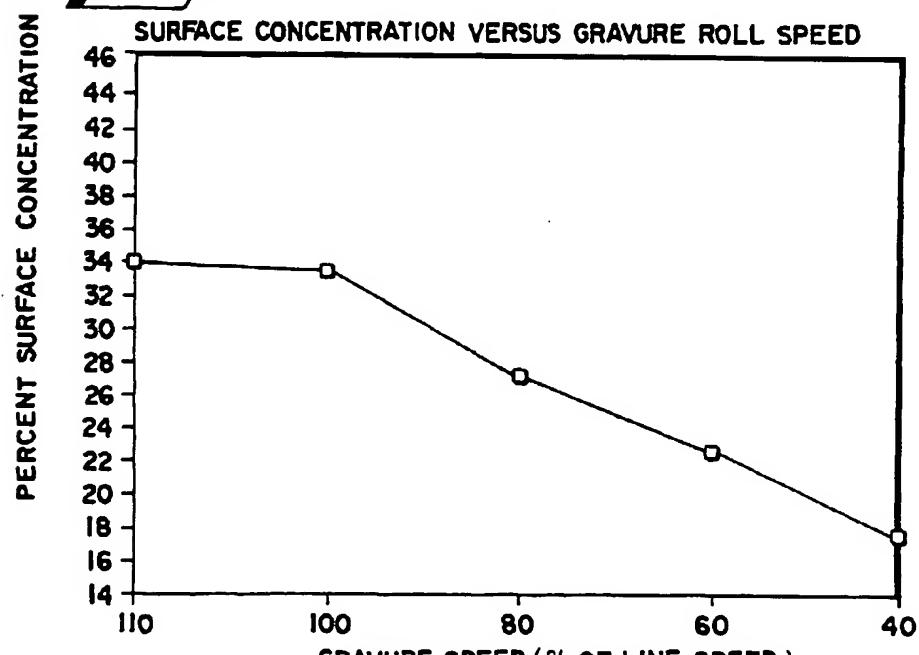
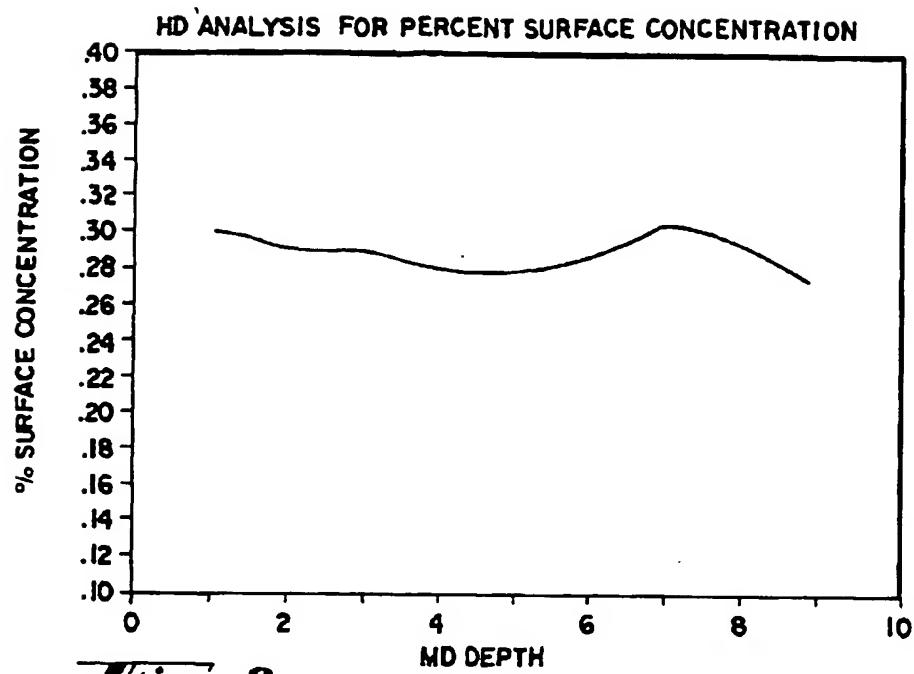


Fig - 4